

# **QBUS 6600 Assignment 1**

## **Big W Project**

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## 1. Introduction

With economic development, people's expectations for a higher quality of life and improved shopping experiences have risen. As the market moves to value and discounted products BIG W has benefitted (David, 2023). Big W is one of the longest-serving department stores in Australia. Since 1964, the retailer has operated as a division of Woolworths Group and has more than 180 stores across Australia and Asia (Upgrowth, 2018). It caters to these expectations by offering a wide range of products, from clothing to electronics, at competitive prices. Big W's extensive network of physical stores in major Australian cities ensures accessibility for local residents. Furthermore, its recent foray into online shopping offers customers the convenience of choosing digital delivery or click collect.

This report analyses sales data from Big W's business in Australia from July 2021 to May 2023 to identify key influencing factors of total sales. Prior to commencing our analysis, it is essential to address data quality across multiple dimensions. For completeness, it is imputed quantitative missing values with medians and categorical missing values with modes, preserving logical and continuous data distribution. For accuracy, employing the interquartile range algorithm to systematically eliminate missing values is critical. As shown in appendix 1, this process also prepares the data for timely analysis, reinforcing its relevance and utility in decision-making.

## 2. Business scope

Big W sets itself apart from traditional competitors through its innovative business model. They have a high-traffic website which complements their large in store network. Relevant factors encompass the nature and quantity of commercial channels. For a more granular analysis of its business footprint, it becomes imperative to reclassify "Digital Click & Collect" and "Digital Delivery" as metrics within the Digital Commerce category. This reclassification enables a meaningful comparison with the count of offline stores. As depicted in Figure 1, in Australia, e-commerce constitutes a substantial 58% share of Big W's total sales, with a staggering 248 online stores supporting Big W across various platforms, nearly 1.5 times the number of physical stores. This shift is a result of Woolworths working hard to embed its position as Australia and New Zealand's largest first-party e-commerce retailer, it had also focused on growing its third-party marketplace presence through its Everyday Market platform, and more recently through the acquisition of MyDeal (David, 2023).

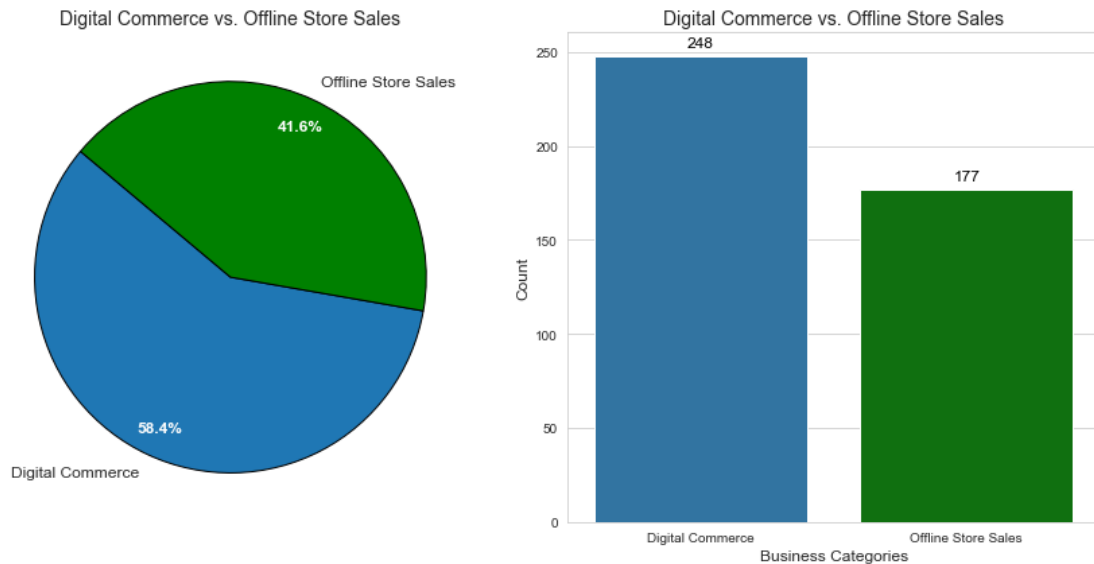


Figure 1. Pie and Bar charts of Big W's digital commerce sales and offline stores sales

According to figure 2, Big W's e-commerce operations are further divided into two distinct modes: Digital Click & Collect, accounting for a substantial 71.4%, and Digital Delivery, representing a more modest 28.6%. The prevalence of Digital Click & Collect suggests Big W's potential concerns about higher logistics costs associated with Digital Delivery, such as shipping expenses. An intriguing discovery is that the number of stores offering Digital Click & Collect matches the number of physical stores, both totalling 177. This implies that Big W's physical stores may not only serve the traditional in-store shopping model but also double as an electronic platform for customers to place orders online and collect them in-store.

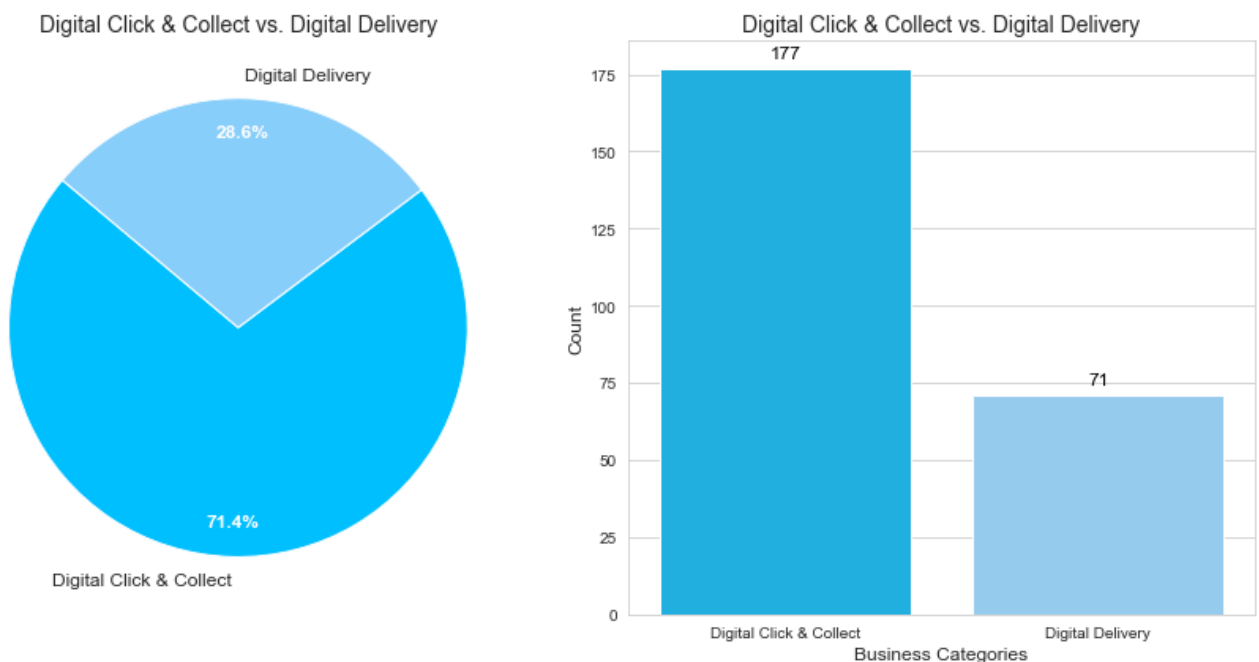
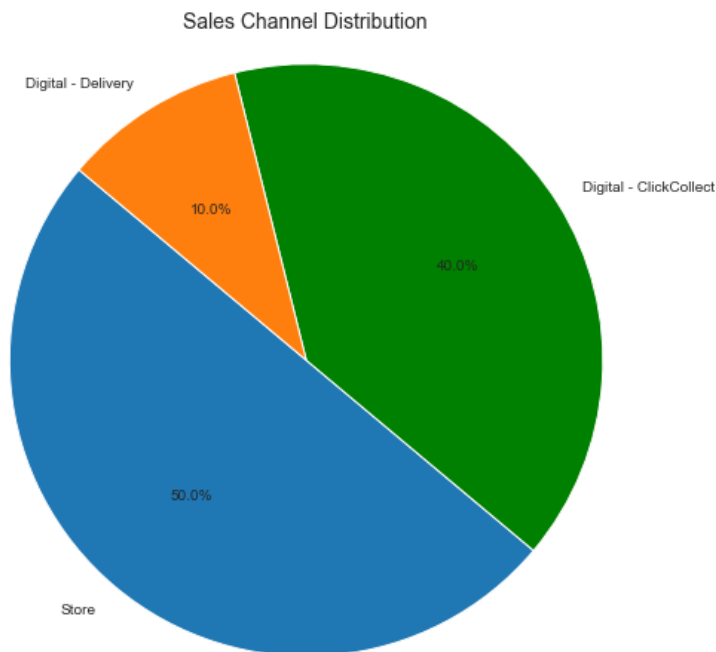


Figure 2. Pie and Bar charts of Big W's digital click& collect sales and digital delivery sales

However, Figure 3 shows that pure-play e-commerce constitutes only 10.7% of Big W's overall business, indicating that they have some ground to cover to compete with industry leaders like Amazon. In general, Big W does not adhere strictly to traditional retail or a fully-fledged e-commerce model; instead, it combines the strengths of both, offering customers a diverse and convenient array of options



*Figure 3. Pie of Big W's business scope*

### 3. Store Locations

Pertinent factors primarily revolve around state counts, longitude, latitude, and proximity to competitors. The distance to competitors is currently represented as categorical data within the dataset. To facilitate more precise analysis, it is essential to encode these categories. For instance, "Same Center" can be assigned the value 1, "<1km" can be denoted as 2, and so forth.

In the context of e-commerce, Big W recognizes the importance of bolstering its offline store sales, which continue to be the primary revenue source (Upgrowth, 2018). As shown in Figure 4, NSW leads the way with 143 stores, comprising 33.6% of Big W's Australian footprint. QLD closely follows with 107 stores, making up 25.2% of the total. VIC ranks third with 74 stores, representing 17.4% of the overall count. These three states excel due to their dense populations and thriving local economies, aligning well with Big W's growth strategy.

Moreover, WA and SA have a nearly equal presence, each with 39 (9.2%) and 36 (8.9%) stores, respectively. While economically developed, these states have smaller populations and potentially

lower consumption levels, which could explain Big W's measured investment.

In contrast, Big W's expansion into ACT, TAS, and the Northern Territory NT remains limited due to their smaller populations and economic challenges, particularly in TAS and NT.

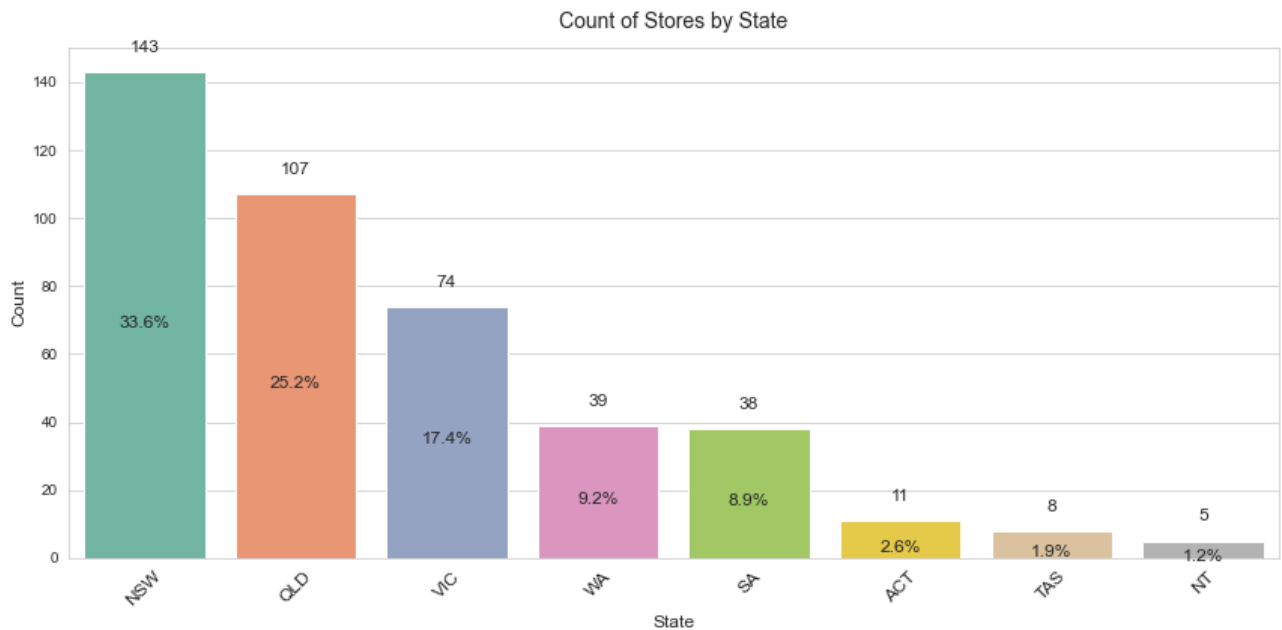
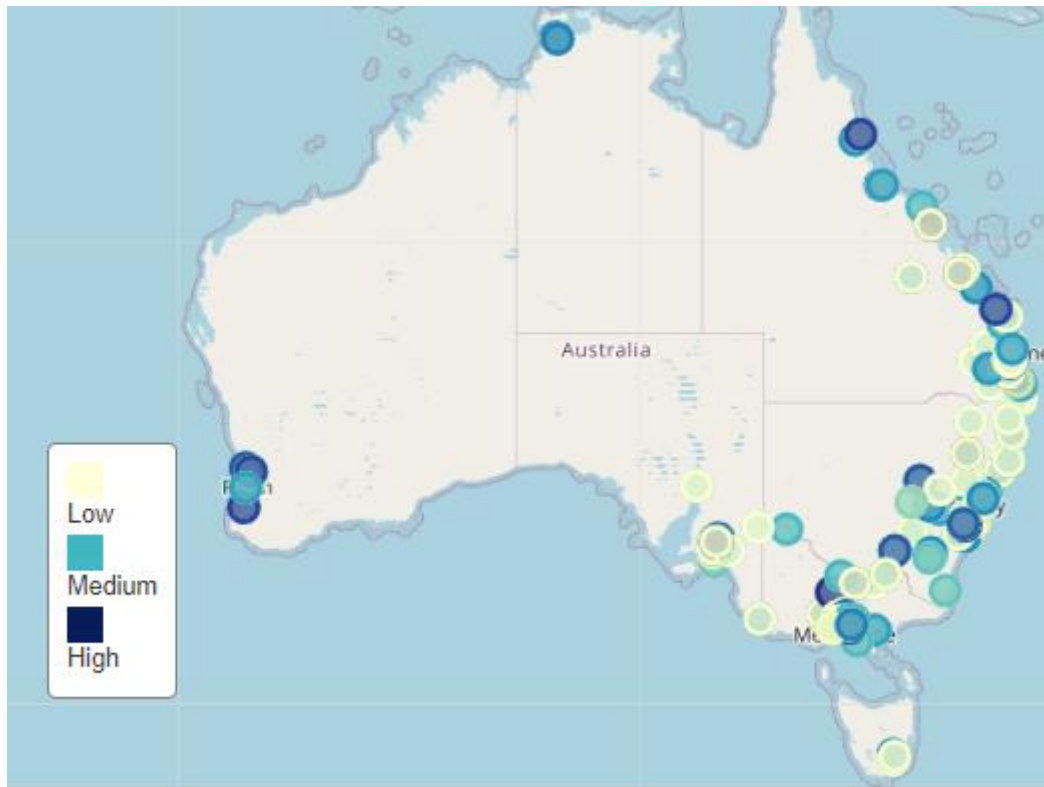


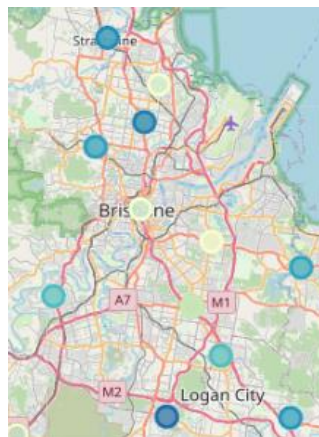
Figure 4. Histogram of Big W's stores in each state

On the other hand, both the location and quantity of stores can potentially impact sales. As depicted in Figure 5, it's evident that a significant portion of Big W stores are situated in the south-eastern coastal regions. This geographical concentration likely aligns with thriving and well-developed areas, in sync with Big W's market positioning and sustained growth strategy. Conversely, many low-performing stores tend to be located inland or in mountainous regions, possibly due to limited accessibility or lower population density.

Figure 6 provides a detailed analysis of Big W's market presence in Brisbane. Big W Stores located on main streets may exhibit better sales performance, as they benefit from higher foot traffic and easier access to potential customers. However, even stores in city centers can face challenges, possibly influenced by external factors such as competition. For instance, sales at the Brisbane city center Big W store may be lower than those at suburban stores.



*Figure 5. Choropleth map of Big W's stores in Australia*



*Figure 6. Choropleth map of Big W's stores in Brisbane*

Figures 6 and 7 provide a comparative analysis of the key competitors of Big W, namely Target and Kmart, in terms of their locations. Out of the 158 Kmart stores, 37.18% (approximately 59 stores) are co-located in the same shopping centers as Big W. Additionally, 134 Kmart stores (31.53%) are situated more than 5 km away from Big W locations. According to Kernel Density Estimation (KDE), it is precisely these two types of Kmart locations that appear to significantly impact Big W's sales. On one hand, Kmart stores within the same shopping centers might divert some customer attention, potentially reducing Big W's sales. On the other hand, Kmart stores located more than 5 km away might diminish the synergy between stores, resulting in fewer business opportunities for Big W. In

other words, maintaining a certain distance from competitors, such as 2 to 4 km, could potentially yield a win-win strategy.

As for Target, most of their stores are located more than 5 km away from Big W. This positioning may contribute to Big W's lower sales figures, indicating that Target may have secured more favorable locations that capture the attention of a larger customer base.

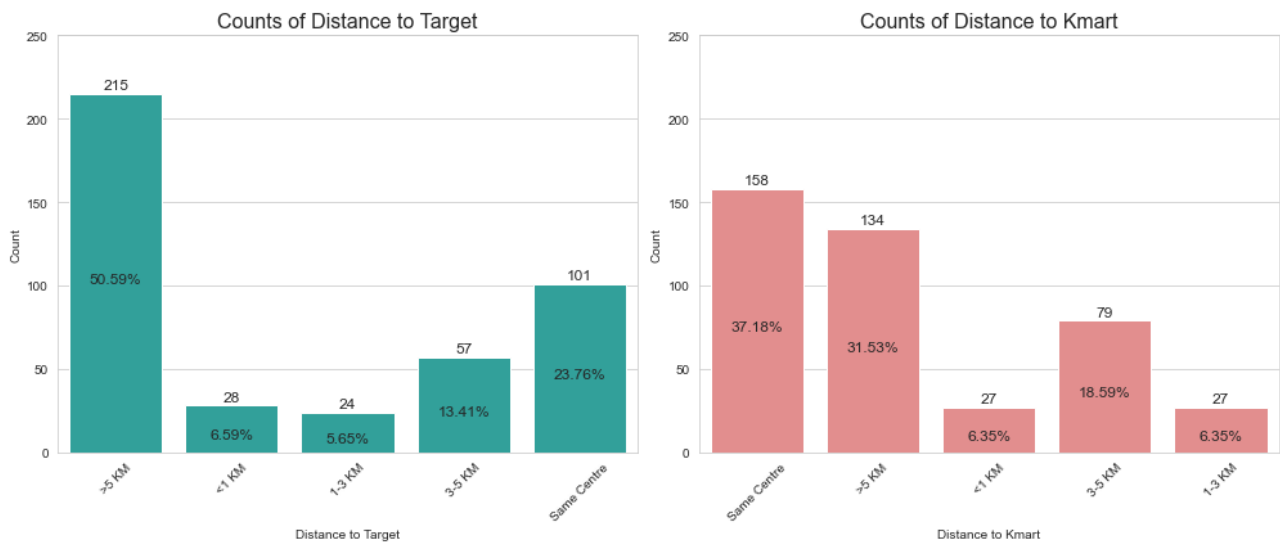


Figure 7. Histogram of distance from Target or Kmart to Big W

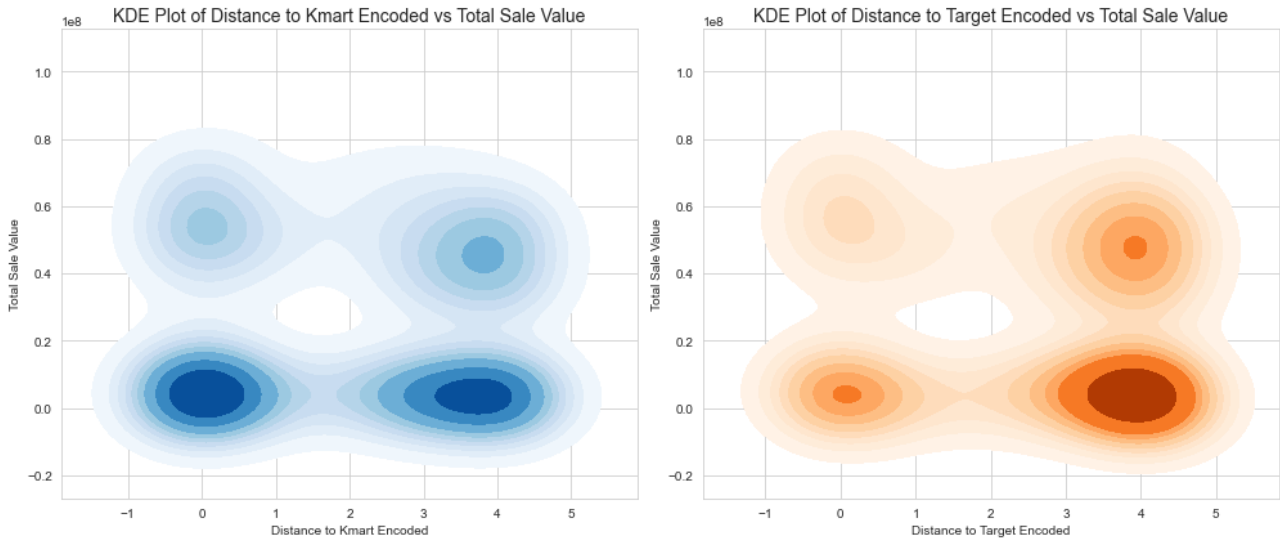


Figure 8. KDE plot of distance from Target or Kmart to Big W

Based on the location analysis, investing in offline stores located in coastal regions and economically prosperous states may be more conducive to boosting sales. On a micro-level, selecting densely populated urban areas and main streets is advantageous for attracting potential customers. Maintaining a distance of 2-4 km from competitors appears to be the optimal strategy, as it allows businesses to tap into their customer base while safeguarding their own customer loyalty.



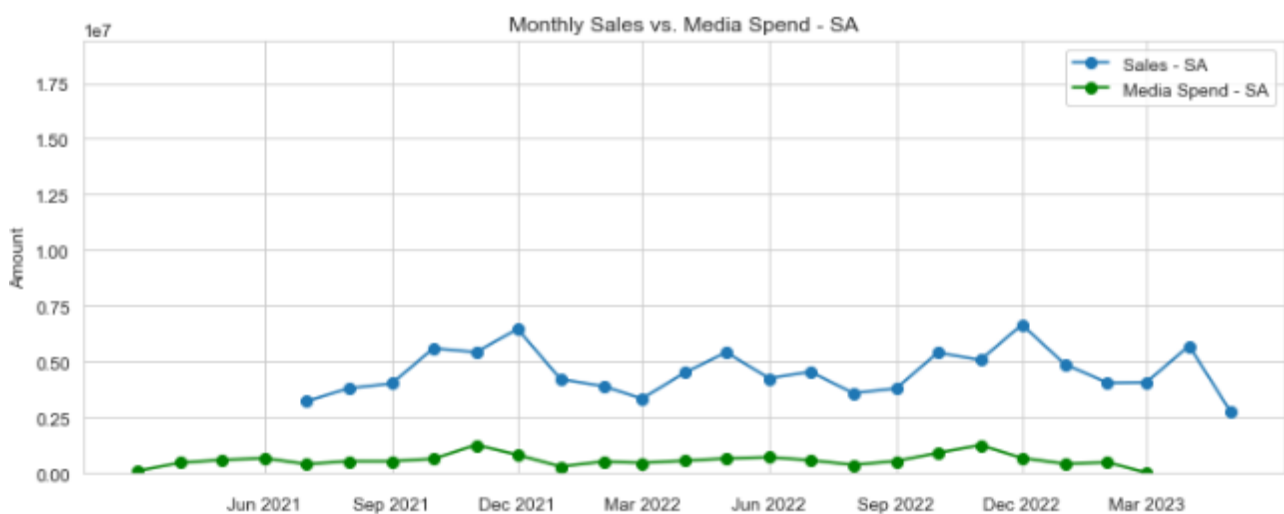
#### 4. Time series

Social media advertising is a key factor influencing sales for Big W, with monthly investments to drive marketing efforts. To analyze patterns, we'll merge data from the Median Investment dataset with the Sales by Customer Location dataset, comparing media impact on sales. Additionally, it is necessary to conduct state-specific time series analysis due to location-based variations.

Firstly, a prominent pattern emerges in seasonality. Across all states, Big W experiences noticeable surges in sales during April and December each year. This surge can likely be attributed to increased customer demand during holiday celebrations, such as Christmas and Thanksgiving. To meet this heightened demand, Big W may enhance its supply chain robustness, including increasing inventory.

Moreover, there may be a potential lag between media spending and its impact on sales. For instance, in SA, Big W invested heavily in social media advertising in November 2022, followed by a sales increase in December. However, another observation is from VIC in September 2021, where media spending was less than sales – this was linked to a product recall of Robo Alive Junior Robotic Baby Shark Bath Toys (Big W, 2021). Because Children using the toy particularly in abbathtub or wading pool can slip and fall or sit onto the hard plastic top fin (Big W, 2021). This suggests that time series models may be influenced by external factors, warranting further in-depth analysis.

Furthermore, it's evident that each state responds differently to media investments, likely due to varying elasticity influenced by local purchasing power and population density. For instance, NSW exhibits the quickest response to media investments, while NT shows minimal responsiveness, potentially due to Big W having only five stores in NT.



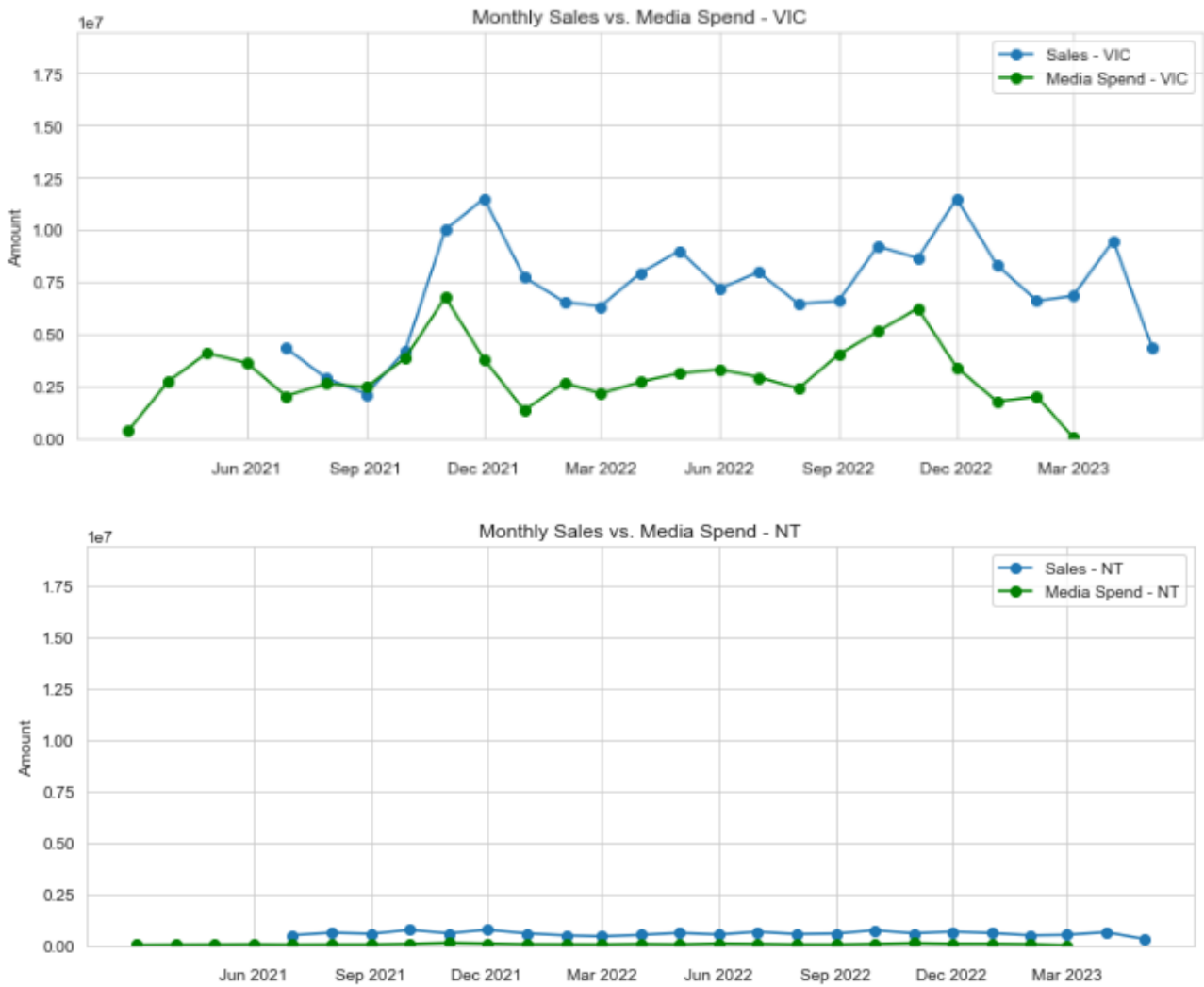


Figure 7. Line charts of total sales and media spend change in 3 states

## 5. Customer segmentation

Market segmentation, also known as audience segmentation, means splitting potential customers into meaningful groups based on their characteristics, wants, and behaviours (Lorna, 2022). It can revolutionize Big W 's marketing strategy. The related features are price and lifestage segment. In order to subdivide the research, it is necessary to split them.

Regarding price segments, Mainstream and Budget customer counts are almost equal. One assumption is that the substantial number of Budget customers could be attributed to Big W's effective marketing promotions. Customers might choose to make purchases during these promotions to manage their budget, potentially boosting customer satisfaction. However, only 27.33% of customers renew their subscription to Premium, indicating that Big W's membership program might still be evolving or the e-commerce aspect is not fully mature.

Examining age groups, around 19.77% of customers are young families, drawn by frequent shopping

and trends. Elderly couples, with higher disposable income, comprise the second-largest group. Middle-aged families are least represented, possibly due to financial constraints from childcare or elderly care responsibilities.

In a broader perspective, Big W may enhance its loyalty among the primary customer segments by catering to the preferences of younger customers with trendy items and offering vintage products preferred by older individuals. It's important to note that this analysis has limitations; the basis for age grouping lacks clarity, such as the definition boundaries between young families and new families, potentially introducing biases.

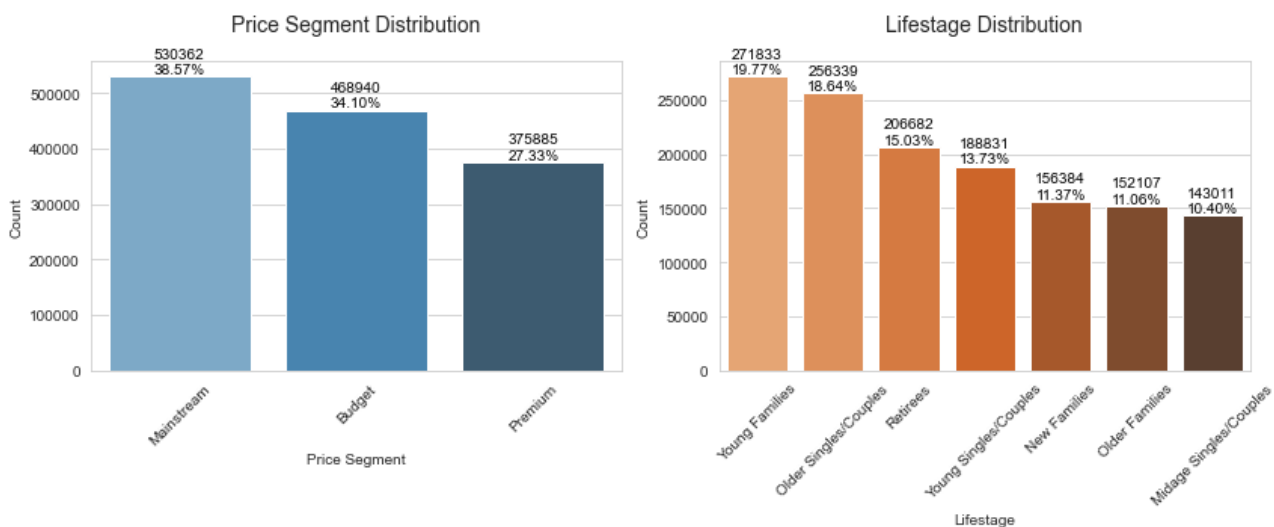


Figure 8. Bar chart of price segmentation and customer age group

## 6. Correlation analysis

To establish the relationship between total sales and other quantitative factors, methods such as distribution analysis, and regression modelling are necessary.

According to figure 11, Big W's monthly store sales primarily clustered around 500,000. This dominance in sales, coupled with its low-cost retail model, contributes to economies of scale, solidifying Big W's industry leadership. Furthermore, the total sales distribution is right-skewed, indicating that the mean exceeds the mode. In other words, a small part of stores significantly outperforms the rest, driving the total sales figure. This suggests the need for Big W to reconsider resource allocation or quality enhancements to balance sales across stores.

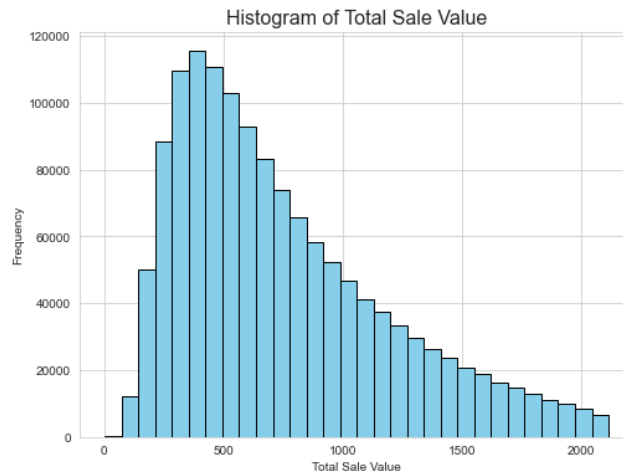


Figure 11. Histogram of Big W's total sales in Australia from July 2021 to May 2023

As shown in Figure 12, the heatmap illustrates the correlation between total sales and various features. significantly, the most significant factors include total promotional value and the three distinct sales channels. Initial results suggest a robust positive correlation between total sales volume, total promotional value, and the count of offline sales while displaying a negative correlation with e-commerce channels.

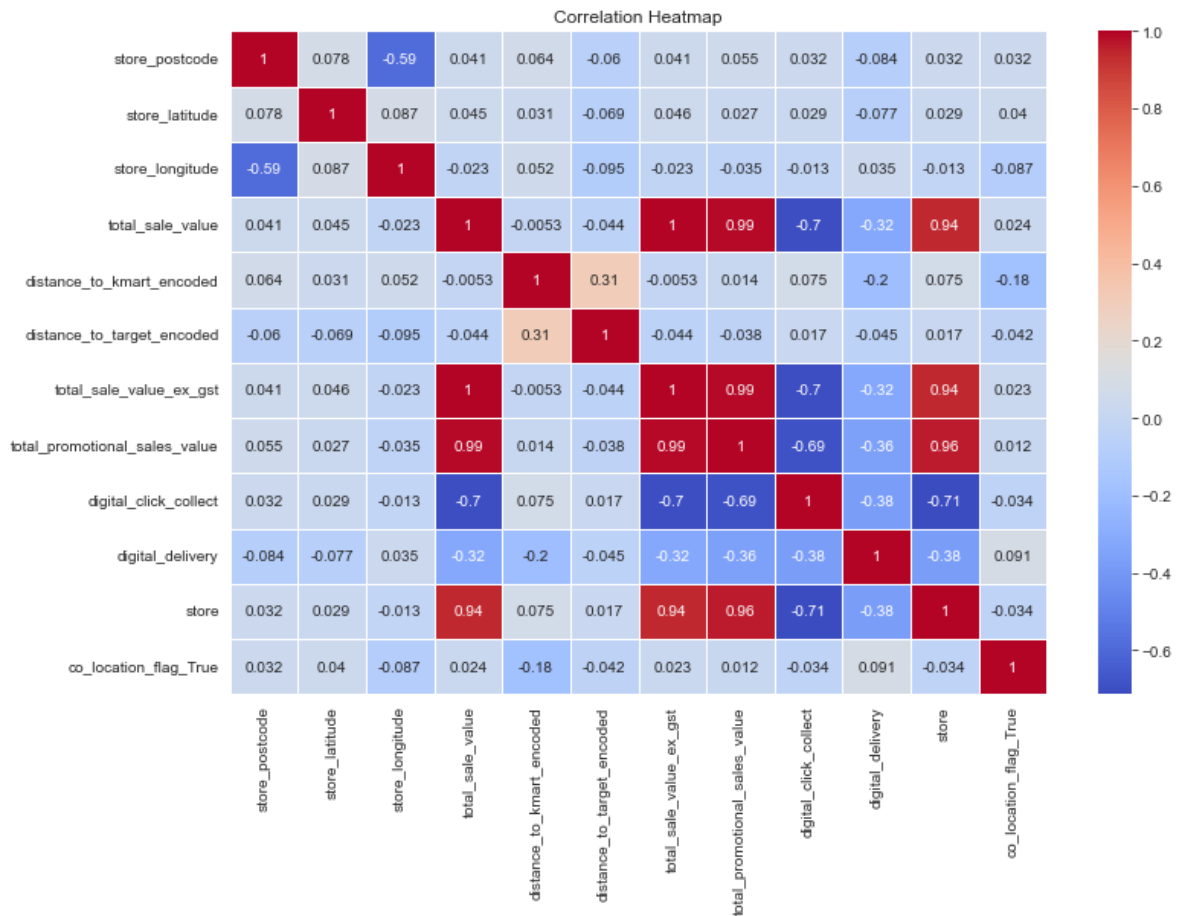
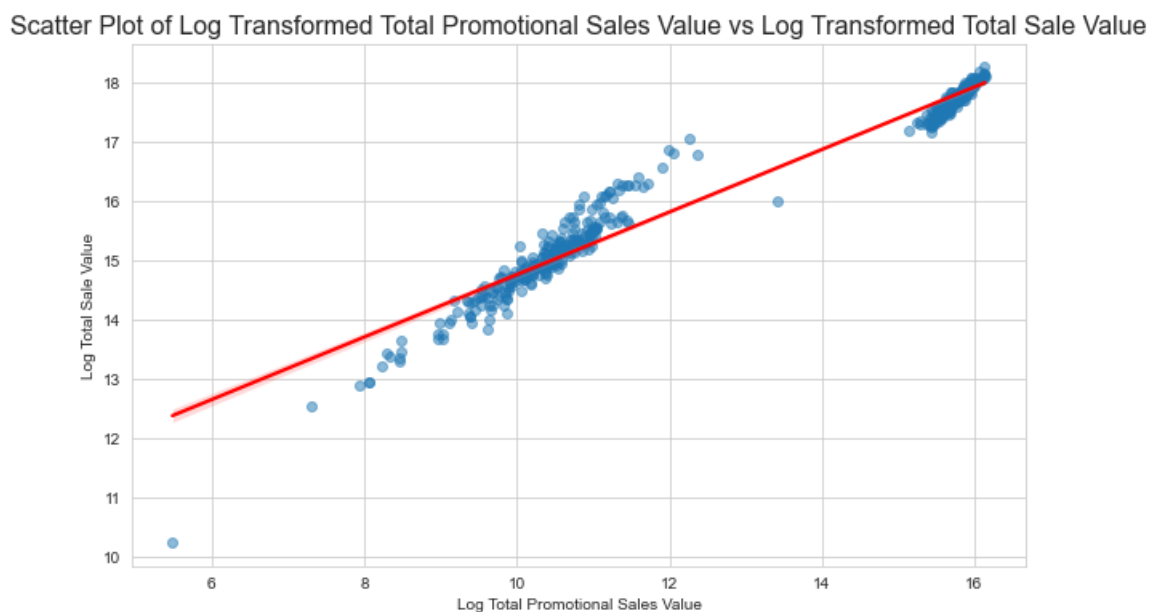


Figure 12. Heatmap of each feature in Big W's dataset

Figure 13 illustrates the potential linear relationship between promotional value and total sales. Given the significant difference in their magnitudes, applying a log transformation can reduce the skewness of the measurement variables and make the distribution approaches normal distribution, thereby ensuring the accuracy of reference intervals. When comparing the trend line, it becomes evident that as promotional activities increase, sales also tend to rise. In other words, the more promotional events, the more total sales, resulting in increased total sales. In light of this, Big W might consider leveraging specific timing, such as festivals, and intensifying promotional efforts to trigger shopping surges, harnessing economies of scale and expanding market share.



*Figure 13. Scatter plot of total promotional sales and total sales value*

In Figure 14, statistical analysis provides valuable insights into the factors influencing Big W's total sales volume. There are positive correlations between customer count, total sale value ex GST, and total promotional sales value, indicating their significant roles in driving higher sales. P values > 0.05 which means there is statistical significance and these variables display strong coefficients, underscoring their importance.

In contrast, there is a negative correlation between transaction count and total sale value, suggesting that simply increasing transaction counts may not necessarily lead to higher total sales. Further investigation is needed to delve into the underlying dynamics of this relationship.

It's worth noting that these insights are derived from linear regression analysis. Future research could explore more advanced techniques like time series modelling and machine learning to uncover nuanced relationships between these factors and total sales. Thus, continuous research and analysis are essential for refining Big W's sales strategy effectively.

OLS Regression Results					
Dep. Variable:	total_sale_value	R-squared:	1.000		
Model:	OLS	Adj. R-squared:	1.000		
Method:	Least Squares	F-statistic:	1.482e+09		
Date:	Sat, 02 Sep 2023	Prob (F-statistic):	0.00		
Time:	00:08:28	Log-Likelihood:	-4.5816e+06		
No. Observations:	1375187	AIC:	9.163e+06		
Df Residuals:	1375182	BIC:	9.163e+06		
Df Model:	4				
Covariance Type:	nonrobust				
	coef	std err	t	P> t	[0.025
const	0.1873	0.013	14.904	0.000	0.163
customer_count	0.2130	0.003	62.816	0.000	0.206
transaction_count	-0.0415	0.003	-13.984	0.000	-0.047
total_sale_value_ex_gst	1.0922	2.29e-05	4.78e+04	0.000	1.092
total_promotional_sales_value	0.0061	9.5e-05	64.570	0.000	0.006
Omnibus:	1611799.267	Durbin-Watson:	2.001		
Prob(Omnibus):	0.000	Jarque-Bera (JB):	235817508.336		
Skew:	-6.163	Prob(JB):	0.00		
Kurtosis:	65.957	Cond. No.	1.76e+03		

Figure 14. OLS regression results of total sales value and other features

## 7. Conclusion

In conclusion, the exploratory data analysis has pointed out several key factors that can significantly impact Big W's total sales. Firstly, Seasonality plays a crucial role, with sales surging during holiday periods. Secondly, strategic social media advertising can yield positive sales outcomes, particularly when timed effectively. Third is Store location, both in densely populated areas and on main streets, which is essential for attracting potential customers. Maintaining a moderate distance from competitors, like Kmart, proves beneficial. Furthermore, understanding customer demographics, including young families and senior couples, allows for tailored product offerings. To capitalize on these insights, Big W should plan holiday-centric marketing, refine its social media strategy, expand strategically, maintain competitive positioning, and diversify its product portfolio. These managerial actions can pave the way for increased sales, customer satisfaction, and business growth.

However, this report comes with some limitations. Certain categorical factors, such as the definitions of "new families" and "young families" within the age groups, lack clear boundaries and might overlap. In future research, applying machine learning techniques like random forests and boosting could provide a more in-depth understanding of how each factor's unit increase or decrease affects changes in sales volume.

## Reference

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## Appendix

